

# **CITY OF LINCOLN**

## **ROADWAY PAVEMENT CONDITION INDEX**

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## 1. EXECUTIVE SUMMARY

This roadway condition index was developed during the fall of 2012 by Prairie Engineers of Illinois, P.C. for the City of Lincoln, Illinois. Two of the primary goals of this roadway condition index are to assist in the development of funding levels required to effectively manage the City's roadway network and to identify which roadways require maintenance, rehabilitation, and reconstruction within the next three to five years.

### 1.1 Scope of Project

This document is intended to summarize the methodologies and rating systems used, and detail the results and recommendations developed during this project. The current conditions of all paved roadways under the jurisdiction of the City of Lincoln were assessed using visual inspections of the surface conditions of the roadways. The system used to rate street conditions is based on the PASER system as developed by the University of Wisconsin and modified to additionally reflect the "ride-ability" or smoothness of each street.

### 1.2 Pavement Management

The efficient management of a roadway network requires proactive maintenance, rehabilitation, and for failed pavements, reconstruction. As pavement condition deteriorates over time, maintenance costs increase significantly. Postponing maintenance required in the early stages of pavement deterioration can be very costly down the road due to the accelerating deterioration of roadway conditions and the need for more costly rehabilitation and reconstruction measures. This roadway condition index is intended to assist in making better decisions regarding where to apply the City's limited funds to best manage the City's roadway maintenance, rehabilitation, and reconstruction programs.

### 1.3 Condition Summary of the City's Overall Roadway Network

The City of Lincoln's overall roadway network is predominantly in fair condition. There is a large percentage of the City's roadways which require either preventative maintenance or rehabilitation. Only a very small percentage (approximately 2 percent) are currently rated as failed, but this percentage is likely to grow significantly over the next 10 years if appropriate steps are not taken to preserve and rehabilitate the roadway network.

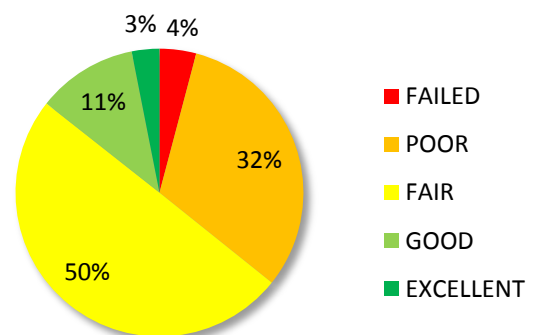


Figure 1.1 Overall Street Ratings (Percent of Streets by Length)

## 1.4 Condition Rating by Functional Classification of Street

The City of Lincoln has jurisdiction over approximately 76 miles of roadway. Of this amount, 5.52 miles are classified as Minor Arterial, 11.18 miles are classified as Collector Streets, and the remaining 59.82 miles are classified as Local Urban streets. See Section 3 (Methodology) for a more detailed description of each functional classification. Ratings for each functional classification of roadway are shown in Table 1.1 and Figure 1.2 below.

	Failed Rating 1-2	Poor Rating 3-4	Fair Rating 5-6	Good Rating 7-8	Excellent Rating 9-10
Arterial Streets (miles)	0.28	1.11	2.03	2.10	0
Collector Streets (miles)	0.07	2.09	5.92	2.96	0.14
Local / Urban Streets (miles)	2.80	21.01	30.21	3.57	2.23
<b>TOTAL ROADWAY (miles)</b>	<b>3.15</b>	<b>24.21</b>	<b>38.16</b>	<b>8.63</b>	<b>2.37</b>

Table 1.1 Condition Ratings by Functional Classification

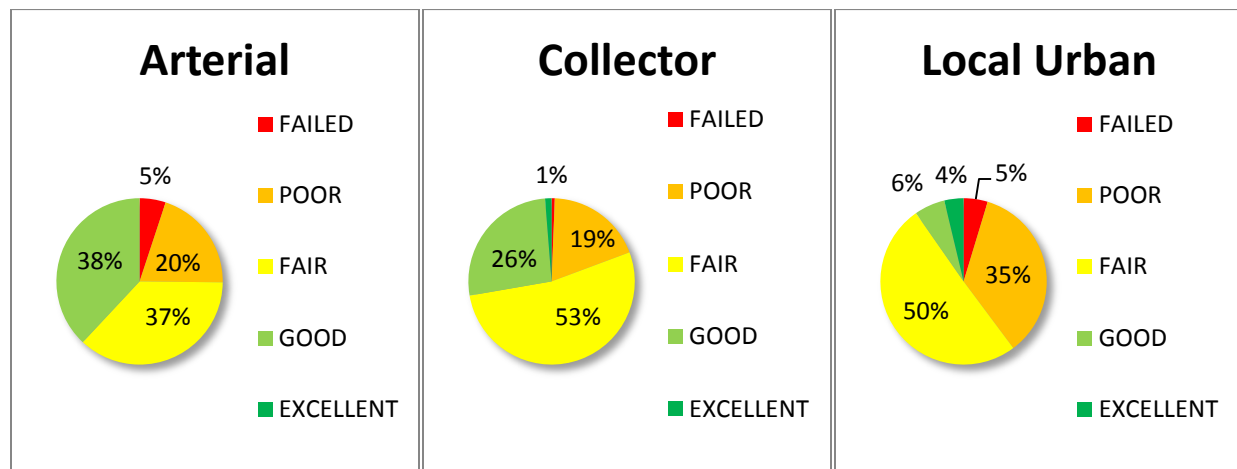


Figure 1.2 Condition Ratings by Functional Classification

As might be expected, the Arterial and Collector Streets are typically in better condition than Local Urban Streets. This is most likely due to the greater emphasis which has been paid to higher classifications of roadways carrying higher traffic loads. Sections of Arterial and Collector roadways which are in poor or failed condition should receive funding priority in any future Capital Improvement Plan.

## 1.5 Condition Rating by Type of Roadway Surface

The vast majority of Lincoln's roadways (approximately 67 miles or 88%) currently have a bituminous (asphalt) surface, with the remainder consisting of concrete and brick roadways. Some of the streets with a bituminous surface have a base of brick or concrete. No effort was made as part of this project to identify the pavement thickness or base material. Ratings for each surface type of roadway are shown in Table 1.2 and Figure 1.3 below.

	Failed Rating 1-2	Poor Rating 3-4	Fair Rating 5-6	Good Rating 7-8	Excellent Rating 9-10
Bituminous Streets (miles)	2.10	20.98	36.58	6.88	0.63
Brick Streets (miles)	0.91	2.87	0.54	0	0
Concrete Streets (miles)	0.13	0.36	1.04	1.75	1.74
<b>TOTAL ROADWAY (miles)</b>	<b>3.15</b>	<b>24.21</b>	<b>38.16</b>	<b>8.63</b>	<b>2.37</b>

Table 1.2 Condition Ratings by Pavement Type

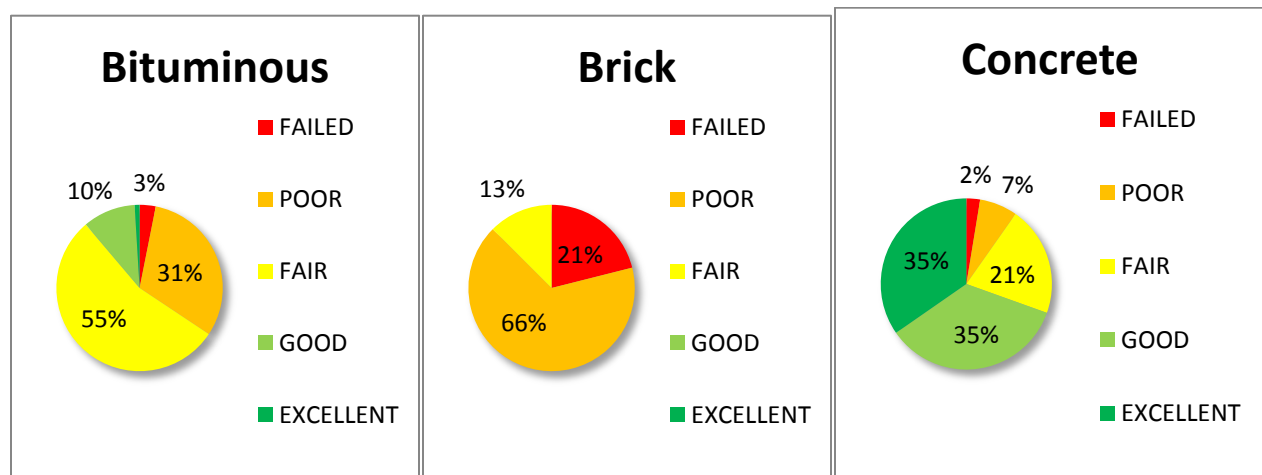


Figure 1.3 Condition Ratings by Pavement Type

The City's brick streets are in generally poor condition, mostly due to their age which is likely 80 to 100 years and poorly repaired utility cuts. The City's concrete streets are generally in good or excellent condition due primarily to the durability of concrete as a paving surface. The condition of the City's bituminous streets varies. These streets are predominantly in fair condition and in need of regular maintenance.

## **2. METHODOLOGY**

The City of Lincoln roadway condition index contained in this report was developed by Prairie Engineers of Illinois, P.C. and was conducted during the Fall of 2012. The roadway condition index is intended to be a numerical indicator of the surface condition of each city Street. This number is derived by observing the distress apparent on the surface of the pavement. Pavement distress is an indicator of structural integrity.

### **2.1 Rating System**

The rating system used for the City's bituminous and concrete streets was the PASER system as developed by the University of Wisconsin. This system was modified to include "ride-ability" (road smoothness) in the evaluation criteria. Additionally, a rating system similar to the PASER system used on bituminous and concrete streets was developed to rate brick streets. Further explanation and information on the rating systems used is contained in Section 3 of this report.

### **2.2 Data Format**

All field data collected was compiled in ESRI GIS .shp file format. Attributes for the rating factors collected were associated with line features, obtained from the Illinois Department of Transportation, for each block of roadway under City jurisdiction. Streets not under the jurisdiction of the City of Lincoln but within the City limits were not rated for this project.

### **2.3 Data Contents**

The data includes width of street, functional classification, average daily traffic, surface type, individual pavement condition ratings, final composite pavement condition ratings, and weighted ratings for each segment of roadway rated.

### **2.4 Data Maps**

Exhibits showing the condition of roadways under City jurisdiction are included in the Appendices of this report. In addition to exhibits displaying the overall street network condition, additional exhibits were developed to display roadway ratings based upon surface type, functional classification, and a rating system weighted by traffic volume.

### **2.5 Surface Type**

Surface types inventoried include bituminous, concrete, and brick. In addition, the presence or absence of street curbing was noted for each street segment.

## 2.6 Functional Classification

The functional classification of roadways can be used to help prioritize streets which typically receive more traffic and are more important to the performance of the City's overall street network. Definitions of each functional classification of roadway in the City of Lincoln include:

**Minor Arterial Streets** – Characterized by their ability to quickly move relatively large volumes of traffic, but often with restricted accessibility to neighboring properties. Arterial systems provide for higher travel speeds and longest travel distances. Examples of arterial streets include 5th Street, Broadway Street, and Union Street between 5th and Woodlawn.

### Minor Arterial

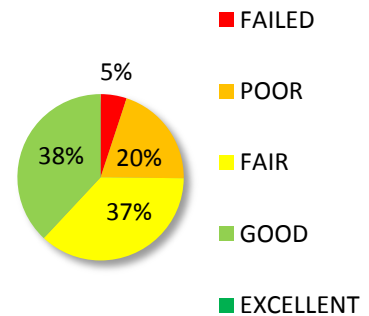


Figure 2.1 Condition Rating of Minor Arterials

### Collector

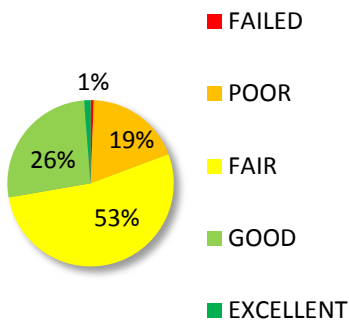


Figure 2.2 Condition Rating of Collectors

**Collector Streets** – Collector streets are a relatively even distribution of access and mobility functions. Traffic volumes and speeds are generally lower than the Arterial streets. Examples of collector streets include College Street north of Woodlawn, Pulaski Street, and Logan Street north of Keokuk.

**Local/Urban Streets** – All public roads and streets not classified as arterials or collectors are classified as local/urban roads and streets. The many points of direct access to adjacent properties characterize local roads and streets. Speeds and volumes are usually low, and the travel distance is usually short.

### Local Urban

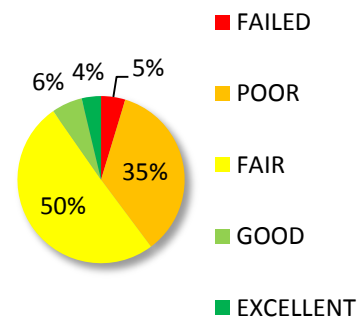


Figure 2.3 Condition Rating of Local Urban Streets

## 2.7 Weighted Rating System

Roadways with higher average daily traffic volumes deteriorate more quickly than roadways with lower volumes, hence improvements and maintenance is required sooner. Additional consideration was given to the traffic volumes by developing an additional “Weighted Final Rating” for each roadway section. This alternate rating was not meant to replace the street ratings developed using the modified PASER method, but instead to prioritize which roadways are selected for improvements and maintenance.

The “Weighted Final Rating” was developed using the following equation:

$$\text{Weighted Final Rating} = \text{Final Rating} - (\text{Average Daily Traffic} / 2000)$$

A map displaying the weighted ratings for all City roadways is provided in Appendix A.

### 3. RATING SYSTEM

#### 3.1 Introduction

All pavements will deteriorate over time. The rate at which pavement deteriorates from an “excellent” state to a “failed” state depends largely on its environment, traffic load conditions, original construction quality, and maintenance procedures that have been performed.

The information compiled in this section describes types and causes of distress and provides an explanation of the PASER system and how to visually rate pavement condition. All of the rating systems used in this roadway condition index are based on the PASER system as developed by the University of Wisconsin. PASER is an acronym for Pavement Surface Evaluation and Rating system. This system visually rates the surface condition of a pavement. Pavements age with time and gradually deteriorate due to environmental effects and traffic loads. The PASER system was developed to enable public works managers to maintain and repair roads more efficiently by documenting the actual conditions of the roads so that a realistic budget can be established for repairs and maintenance.

PASER uses a visual approach to inventory the existing condition of roadways. This is done by dividing the roadway into sections with relatively similar conditions. These sections are inventoried using specific criteria and a final composite rating is developed for each segment of roadway. This system provides an unbiased tool for the development of Capital Improvement Plans by public works professionals.

The below graph is an excellent example of the PASER rating system for prioritizing maintenance schedules. See Figure 3.1 below.



Figure 3.1 Pavement Maintenance Scheduling

### 3.2 Concrete Pavements

Rigid pavements (concrete) carry traffic differently than asphalt. Concrete pavements are built to act like a beam with joints which allows the use of the strength of the pavement to carry the load of the traffic. Concrete slabs need to be able to expand and contract as temperatures change. Concrete pavements are typically built with contraction joints to control the inevitable cracking.

Conditions that are common to concrete pavements are surface defects such as map cracking, pop-outs, scaling and spalling. Pavement cracks can be transverse slab cracks, D-cracking, corner cracks, and meandering cracks. There are also pavement deformations such as blow ups, faulting, pavement settlement or heaving, utility repairs, patches and potholes. Curb or shoulder deformation can result from pavement deformations as well.

When inventorying the different defects found in the City's concrete pavements, both the severity of the problem and the extent of the problem was rated. An evaluation was done on a 1-10 rating scale for each deterioration factor with a value of 10 representing a new road and a value of 1 representing a failed road. In addition, a factor not defined within the PASER system, "ride-ability" or smoothness of each pavement section was taken into account and added into the ratings.

The system ratings are related to needed maintenance or repair as listed in Table 3.1 below.

Surface rating	Distress description	Condition/ Maintenance needed
Ratings 9 & 10	None or traffic wear in wheelpath. Slight map cracking or pop outs.	New pavement or recent concrete rehabilitation. No maintenance required.
Ratings 7 & 8	Pop outs, map cracking, or minor surface defects. Some open joints. Isolated cracks, tight or well-sealed. Some manhole displacement and cracking. First noticeable settlement or heaved area.	More surface wear or slight defects. Little or no maintenance required or minor routine maintenance needed.
Ratings 5 & 6	Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Moderate to severe polishing or scaling over 25% of the surface. High reinforcing steel causing surface spalling. Multiple corner cracks with broken pieces. Moderate settlement or heaved areas.	First signs of joint or crack spalling or faulting. Grind to repair surface defects. Some partial depth patching needed. Needs some full depth repairs, grinding, and/or asphalt overlay to correct defects.
Ratings 3 & 4	Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling, pumping and faulting of joints with fair ride.	Needs some full depth repairs, grinding, and/or asphalt overlay. Needs extensive full depth patching plus some full slab replacement.
Ratings 1 & 2	Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlements. Restricted speed. Extensive potholes. Almost total loss of pavement integrity.	Rebuild pavement or total reconstruction.

Table 3.1 Concrete Pavement Rating Criteria

Ratings were determined by a visual inspection of the surface of each roadway segment. Example ratings are included below as a reference.



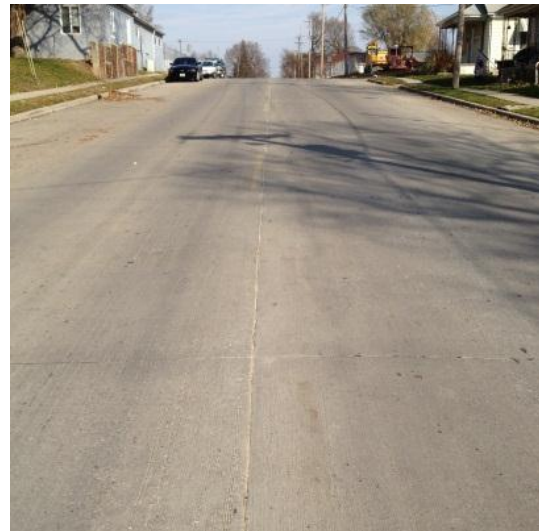
*Burlington Street (Failed Condition)*



*Burlington Street (Fair Condition)*



*Pulaski Street (Good Condition)*



*Kickapoo Street (Excellent Condition)*

### 3.3 Asphalt (Bituminous) Pavements

Just as with concrete, our modified PASER rating system for bituminous streets utilized a visual inspection to assess asphalt surface conditions. The main element to a beneficial evaluation is recognizing different types of pavement distress and then being able to link them to a specific cause.

Asphalt pavement has four different major categories of common surface distress. Those categories are: surface defects, surface deformation, cracks, patches and potholes. The deterioration that occurs within these categories has two main causes: environmental and structural. Environmental causes are mainly due to weather and aging. Structural causes have a much greater variance due to poor quality of materials, poor quality of construction, improper maintenance, and heavier traffic loads. Of course, most pavement deteriorations are a result of both environmental and structural causes and it is important to be able to distinguish between the two.

As with concrete inspection, an evaluation was performed on a 1-10 rating scale with a value of 10 representing excellent condition and a value of 1 representing a failed road. Also just like with the concrete streets rated, a factor not defined within the PASER system, “rideability” or smoothness of each pavement section was taken into account and added into the ratings.

The system ratings are related to needed maintenance or repair as listed in Table 3.2 below.

Surface Rating	Distress description	Condition/ Maintenance needed
Ratings 9 & 10	None to beginning of reflective cracks of transverse paving joints.	New construction/recent overlay – like new.
Ratings 7 & 8	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater) all cracks sealed or tight. Very slight or no raveling, surface shows some traffic wear.  Longitudinal cracks (open ¼") due to reflection of paving joints. Transverse cracks (open ¼") spaced 10' or more apart, little or slight crack raveling.	Recent sealcoat or new cold mix. Little or no maintenance required.
Ratings 5 & 6	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open ¼" – ½"), some spaced less than 10'. First sign of block cracking. Sight to moderate flushing or polishing. Occasional patching in good condition.  Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path.	Shows signs of aging. Sound structural condition. Could extend life with sealcoat or needs sealcoat or thin non-structural overlay.
Ratings 3 & 4	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (1/2" deep or less).  Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking. Patches in fair to poor condition.	Needs patching and repair prior to major overlay. Would benefit from a structural overlay (2" or more). Or needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay.
Ratings 1 & 2	Alligator cracking (over 25% of surface). Severe distortions (over 2" deep). Extensive patching in poor condition. Potholes. Severe distress with extensive loss of surface integrity.	Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective. Or Failed. Needs total reconstruction.

Table 3.2 Asphalt Pavement Rating Criteria

Ratings were determined by a visual inspection of the surface of each roadway segment. Photographs of example ratings are included below as a reference.



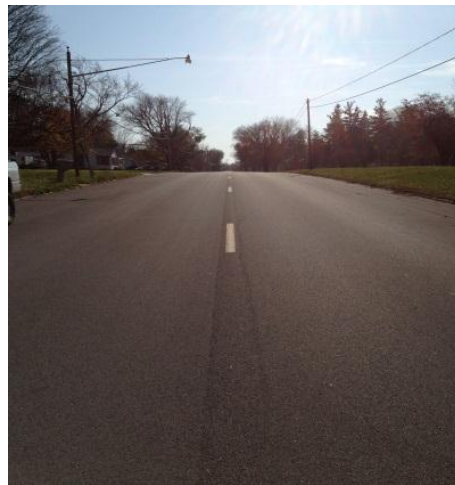
*Oscar Street (Failed Condition)*



*9th Street (Poor Condition)*



*Chicago Street (Fair Condition)*



*State Street (Excellent Condition)*

### 3.4 Brick Pavements

Unlike with Asphalt and Concrete Streets, none of the City's brick streets are in good or excellent condition. All of the Brick streets remaining have surpassed their life expectancy, and they are typically in poor condition.

The brick pavement rating system used for this project was developed by modifying the PASER system for brick streets (1 to 4 rating system) to develop a method that corresponded with the systems used for bituminous and concrete streets (1 to 10 rating system). The viewable distresses observed on the brick pavements were used as the basis of deficiency for the segments. Like concrete and asphalt streets, a ride-ability rating was added.

Maintenance and/or replacement is necessary for all of the City's brick streets. Streets with a fair rating can be maintained by removing and repairing previous concrete and asphalt patches with new brick repairs. Streets with a poor or failed rating may need to be reconstructed.

Ratings were determined by a visual inspection of the surface of each roadway segment. Example ratings are included below as a reference.



*7th Street (Failed Condition)*



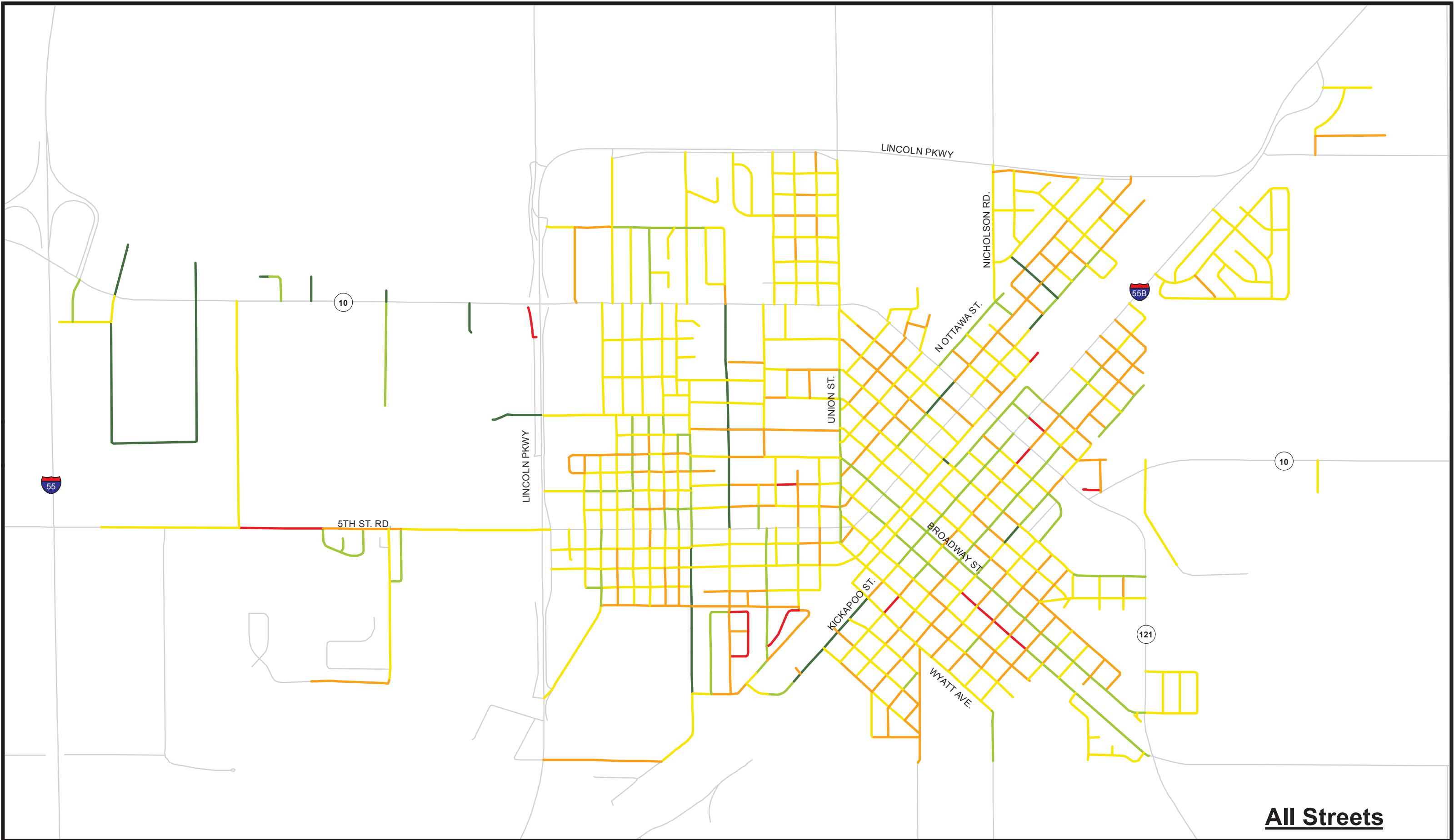
*McLean Street (Poor Condition)*



*Pekin Street (Fair Condition)*

Appendix A

Roadway Pavement Condition Rating Map (All Streets)



**All Streets**

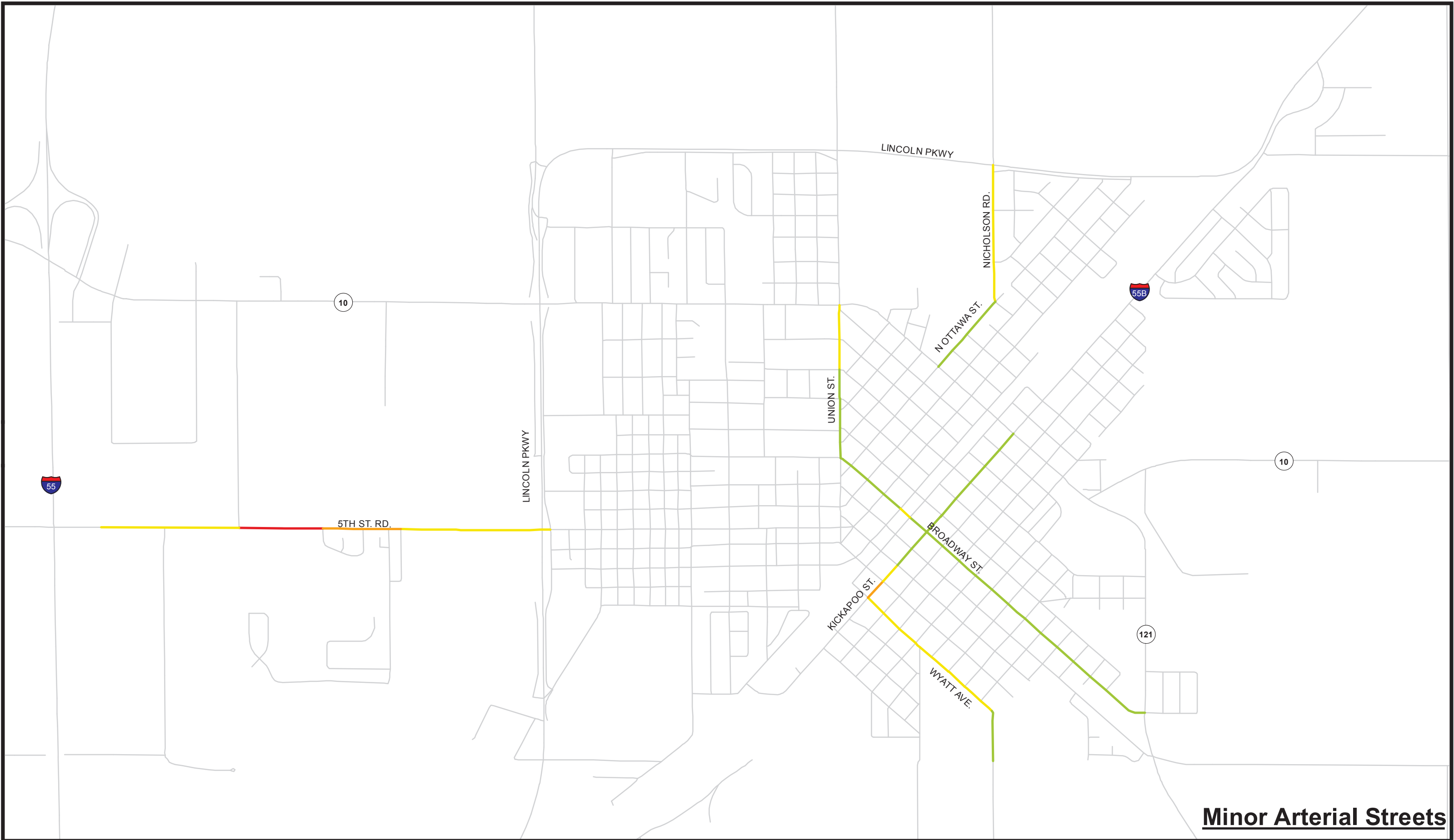


Pavement  
Condition  
Rating

- |             |             |                             |
|-------------|-------------|-----------------------------|
| 0 - 2.50    | 4.51 - 6.50 | 8.51 - 10.00                |
| 2.51 - 4.50 | 6.51 - 8.50 | Other Jurisdiction Entities |

# Street Inventory Lincoln, IL

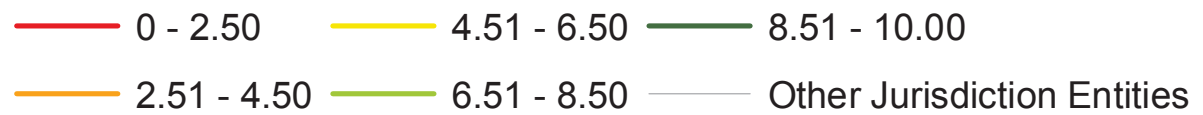




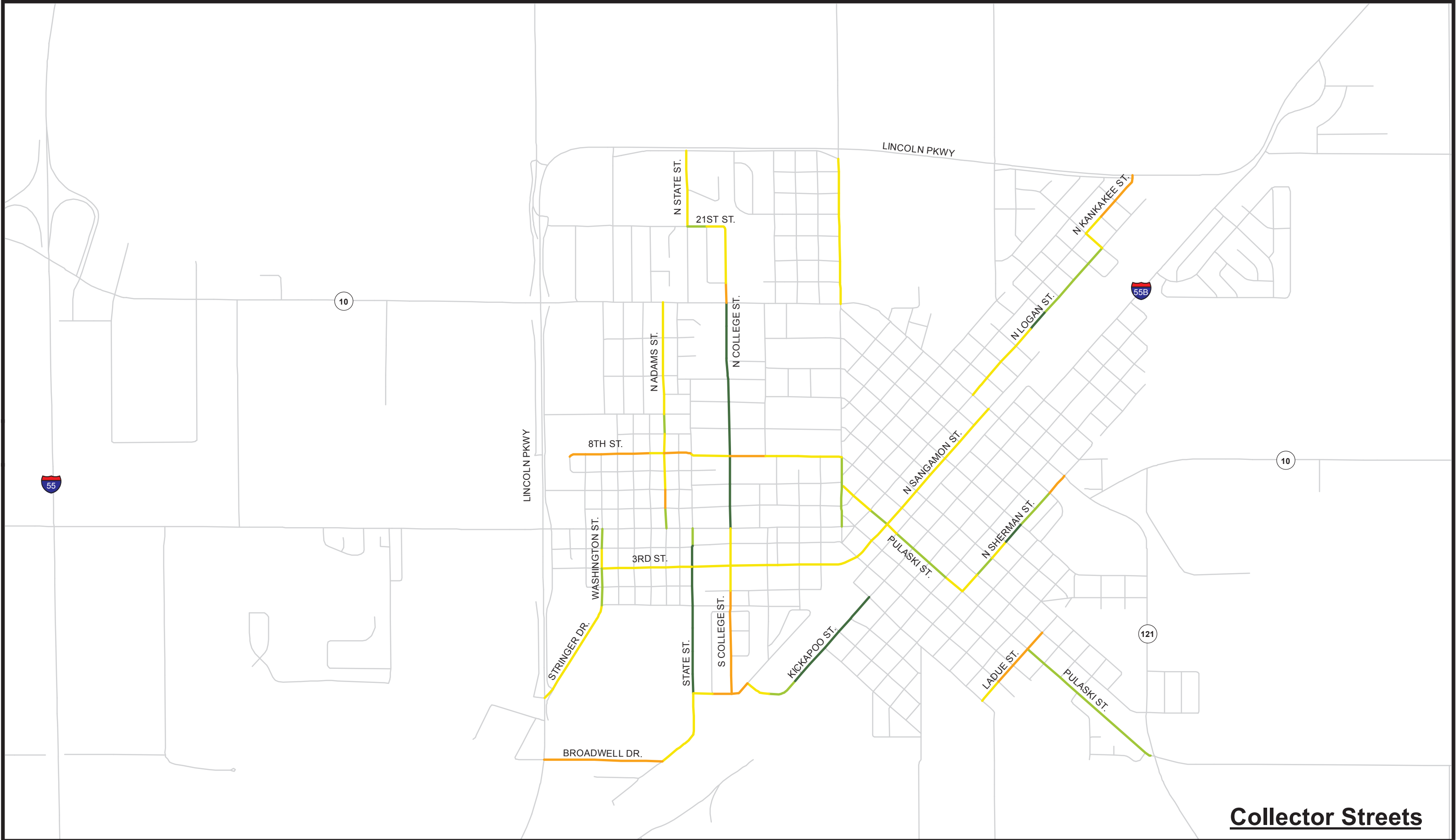
**Minor Arterial Streets**



Pavement  
Condition  
Rating



**Street Inventory  
Lincoln, IL**

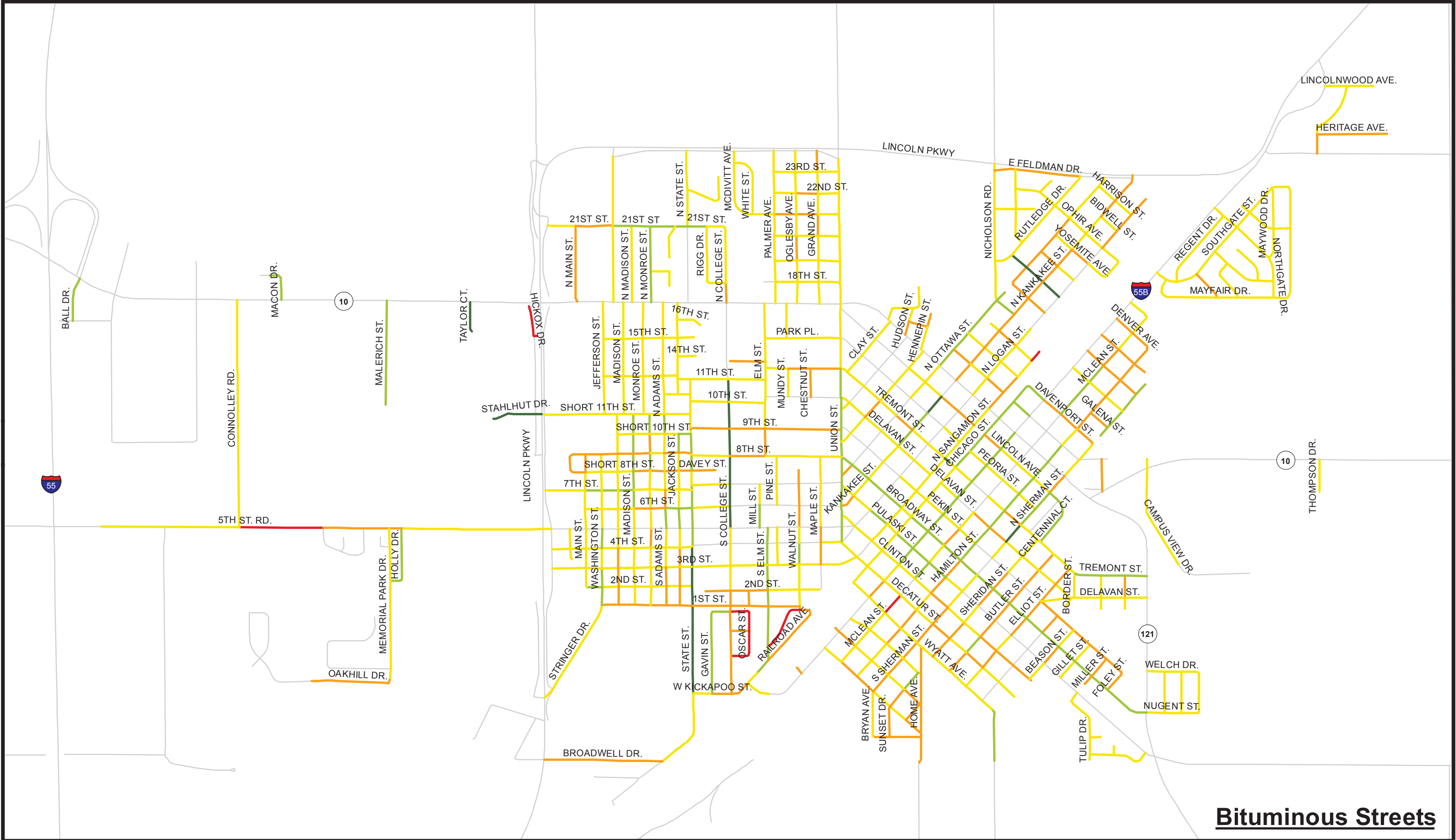


**Collector Streets**



Appendix C

Roadway Pavement Condition Rating Maps (By Pavement Type)



**Bituminous Streets**



Pavement  
Condition  
Rating

0 - 2.50

2.51 - 4.50

4.51 - 6.50

6.51 - 8.50

8.51 - 10.00

Other Jurisdiction Entities

# Street Inventory Lincoln, IL



**Brick Streets**



Pavement  
Condition  
Rating



# Street Inventory Lincoln, IL



**Concrete Streets**



00.250.51Miles



Pavement Condition Rating

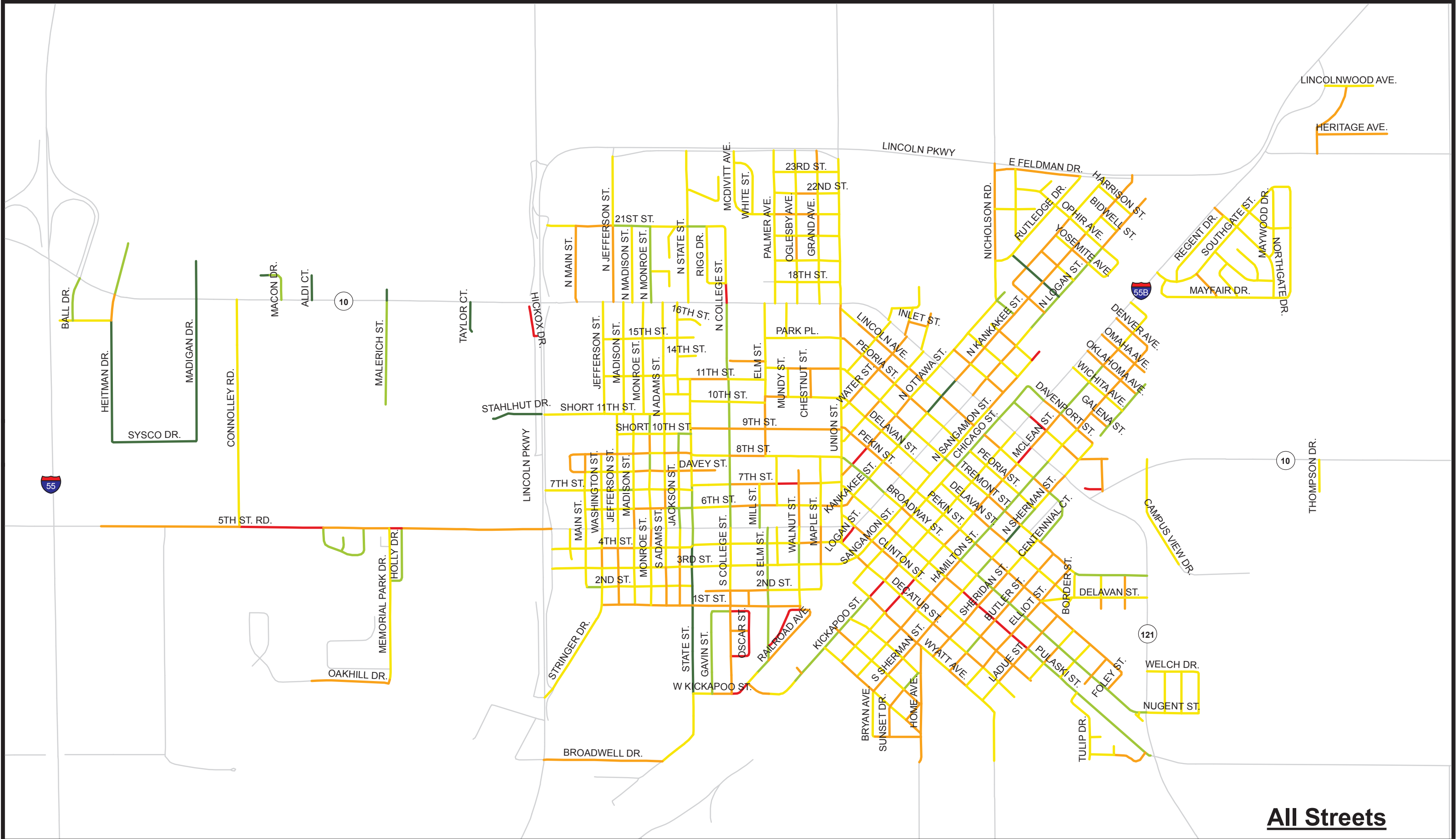
 0 - 2.50	 4.51 - 6.50	 8.51 - 10.00
 2.51 - 4.50	 6.51 - 8.50	 Other Jurisdiction Entities

Street Inventory

Lincoln, IL

Appendix D

Weighted Condition Rating Map (All Streets)



**All Streets**



Weighted  
Pavement  
Condition  
Rating

0 - 2.50

2.51 - 4.50

4.51 - 6.50

6.51 - 8.50

8.51 - 10.00

Other Jurisdiction Entities

# Street Inventory Lincoln, IL